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Research paper

Unravelling the internal and external drivers of digital servitization: A dynamic capabilities and contingency perspective on firm strategy

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ABSTRACT

Despite the increased interest in using digital technologies for servitization purposes, little is known about what drives firms towards a digital servitization strategy. Using a dynamic capabilities lens, we look into the relationships between two organizational mechanisms – exploitation and exploration – and firms' orientation towards digitization, servitization and digital servitization. On top, we examine the influence of two environmental contingencies – technological turbulence and competitive intensity – as potential influencers of these relationships. We collected and analyzed data of 139 Belgian firms through hierarchical regressions. Exploitation and exploration are positively associated with digital servitization, but exploration trumps the effect of exploitation when firms do both. Technological turbulence is positively associated with digitization regardless of the firm's level of exploration or exploitation, and competitive intensity only relates positively with servitization when firms emphasize exploration. Theoretically, we contribute to the literature by unravelling the relationship between firms' dynamic capabilities and their environment. In order to fully understand firms' strategic transition towards digital servitization, both should be considered. As managerial implications, we suggest that firms pay close attention to adapting their strategy to fit an increasingly changing environment.

1. Introduction

Firms today are confronted with two disruptive changes. For one, customers increasingly expect suppliers to combine products with high service quality, and help them save costs while reducing their risk (Raddats, Baines, Burton, Story, & Zolkiewski, 2016). In order to meet such heterogeneous demands, firms are refocusing their strategy from supplying basic products and services to providing integrated, value-added solutions (Kuijken, Gemser, & Wijnberg, 2017; Matthyssens & Vandenbempt, 2008). This transition is referred to as 'servitization' (Raddats, Kowalkowski, Benedettini, Burton, & Gebauer, 2019; Vandermerwe & Rada, 1988). Second, the analog world is becoming more and more digital (Tilson, Lyytinen, & Sørensen, 2010). The growing availability of data, the connectivity of products and the emergence of advanced analytics blur traditional boundaries between actors, sectors and even markets (Porter & Heppelmann, 2014). This evolution is known as 'digitization' (Storbacka, 2018). Servitization and digitization are increasingly being considered related concepts (Frank, Mendes, Ayala, & Ghezzi, 2019), and offering solutions through the use of digital technologies has been referred to as 'digital servitization' (Kohtamäki, Parida, Oghazi, Gebauer, & Baines, 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). New digital technologies in production, sales and delivery support firms in offering customized solutions for a wider range of applications and markets (Coreynen, Matthyssens, & Van Bockhaven, 2017; Kindström & Kowalkowski, 2014). On top, digital platforms enabled by the Internet of Things (IoT) allow companies to connect with products like never before and offer a whole range of other services, from remote monitoring to providing fully autonomous systems of products (Cenamor, Rönnberg Sjödin, & Parida, 2017; Matthyssens, 2019). Despite its ample opportunities, digital servitization is considered "a strategic decision with profound implications" (Bustinza, Gomes, Vendrell-Herrero, & Tarba, 2018, p. 112), and it may take several years before digital servitization creates value for the organization, if at all (Kohtamäki, Parida, Patel, & Gebauer, 2020).

To date, many studies have focused on the impact of technology on

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firms' service business model (e.g., Coreynen et al., 2017; Frank et al., 2019), but few have considered what happens before – what are the initial drivers of firms to pursue digital servitization? Previous research has associated 'exploitation' (March, 1991) with using technology to improve products, services and processes, and 'exploration' with creating new business opportunities through product-service innovation (e.g., Bustinza, Vendrell-Herrero, & Gomes, 2019; He & Wong, 2004). Does this translate to similar associations between exploitation and digitization, on the one hand, and exploration and servitization, on the other hand? And if so, is a combined exploitation-exploration capability (i.e., ambidexterity; O'Reilly & Tushman, 2008) the necessary condition for firms pursuing a combined digital servitization strategy? Furthermore, the context in which firms operate matters (Dmitrijeva, Schroeder, Bigdeli, & Baines, 2019), as not only internal but also external factors influence strategic decision-making (Miller, 1981). For example, different levels of competition have been associated with firms pursing different service strategies (Gebauer, 2008; Morgan, Anokhin, & Wincent, 2019), and technological change may not only enable service growth (Frank et al., 2019) but also hinder it (Finne, Brax, & Holmström, 2013). To what extent does the environment influence firms' orientation towards digital servitization, considering their emphasis on either exploitation or exploration? For instance, are exploitative firms more likely to turn technological change into digital strategy (e.g., to increase efficiency)? And are explorative firms more likely to counter competitive pressures by developing new service business opportunities?

The aim of this paper is to unravel the organizational drivers of digital servitization. We seek to answer two main research questions. First, what internal factors are associated with firms' orientation towards digitization, servitization, and a combined digital servitization strategy, and to what extent do they differ for each strategy? To answer this set of questions, we apply a dynamic capabilities perspective (Eisenhardt & Martin, 2000; Teece, 2007), and build on prior technology and innovation studies on exploitation, exploration (March, 1991) and ambidexterity (O'Reilly & Tushman, 2008, 2013). Second, what external factors moderate these dynamic capability-strategy relationships? Here, we use a contingency lens (Miller, 1981) to evaluate the extent to which different environmental circumstances further strengthen (or weaken) the associations between our key constructs. Specifically, we zoom in on the speed of technological change and intensity of competition (Jaworski & Kohli, 1993), which have already been pinpointed as potential influencers of firms' digital service transition (e.g., Finne et al., 2013; Morgan et al., 2019). In summary, the purpose of this study is to develop insight into the internal (i.e., dynamic capabilities) and external (i.e., the environmental contingencies) factors that influence strategic decision-making related to digital servitization.

This study contributes to the current servitization research field in three ways. First, we address the call for studies on strategic capabilities in digital servitization (Kohtamäki, Parida, et al., 2019). Particularly, we intend to find whether exploitation, exploration or ambidexterity (i.e., emphasizing both capabilities) are associated with firms' pursuit of digital servitization, and thus necessary for firms to develop such a strategy. Second, we address the call for more research that considers the influence of the environment on firms' digital servitization transition (Fliess & Lexutt, 2017). This way, we can find whether different capabilities are more (or less) associated with digital servitization in specific technological and competitive contexts. Third, by pulling apart the concepts of 'digitization' and 'servitization', and investigating their associations with both internal and external factors, we gain further insights in the connections and differences between these two strategies (Frank et al., 2019; Kohtamäki et al., 2020). These three elements offer significant theoretical contributions to the literature, which despite the growing number of publications is still considered in a theoretically nascent stage (Kowalkowski, Gebauer, & Oliva, 2017b).

Methodologically, we follow a quantitative, deductive approach, formulating different hypotheses based on the consulted literature, followed by a thorough analysis of the data collected for this study. This approach is particularly suited for our research as it enables us to find empirical support against or in favor of previous assumptions on digital servitization (e.g., Fischer, Gebauer, Gregory, Ren, & Fleisch, 2010), and also compare different associations between our key constructs. It also adds to the current body of literature, which thus far consists mostly of qualitative studies that explore servitization in often a descriptive manner without further investigating the suggested relationships (Fliess & Lexutt, 2017; Raddats et al., 2019).

The paper is structured as follows: First, we review the literature to excavate prior research, connect different theoretical perspectives, and develop hypotheses. Second, the study's research methodology is introduced, including how the data was collected and analyzed. Third, we report the study's results and relate the (non-)evidence to our hypotheses. Fourth, the main findings are confronted with the consulted literature. Finally, we summarize the main theoretical contributions, and offer several managerial implications and suggestions for future research.

2. Theory

2.1. Servitization, digitization and digital servitization

The term 'servitization' was first introduced by Vandermerwe and Rada (1988), who described how firms are "moving from the old and outdated focus on goods or services to integrated 'bundles' or systems … with services in the lead role" (p. 314). Over the past three decades, the scientific interest in servitization has been growing exponentially and has produced over a thousand articles (Fliess & Lexutt, 2017; Rabetino, Harmsen, Kohtamäki, & Sihvonen, 2018). The main focus has been on manufacturers of industrial equipment (Baines & Lightfoot, 2013); well-known examples are Rolls Royce's Power-by-the-Hour service, which offers guaranteed flight hours for its airplane engines, and Xerox' Document Management services for its office printers (Kowalkowski et al., 2017). Besides manufacturers, other firms are servitizing as well. There have been studies in the maritime sector (Pagoropoulos, Maier, & McAloone, 2017), road transport sector (Bigdeli, Bustinza, Vendrell-Herrero, & Baines, 2017), publishing (Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017), music (Parry, Bustinza, & Vendrell-Herrero, 2012) and even the agricultural sector (Pereira, Carballo-Penela, González-López, & Vence, 2016). For example, transportation firms are unburdening customers by creating fully-integrated logistics models (Hedvall, Jagstedt, & Dubois, 2019), and pesticide firms are helping farmers by taking over the complete management of their crops' health (Pereira, Carballo-Penela, Guerra, & Vence, 2018). In summary, servitization today truly is "pervading almost *all* industries" (Vandermerwe & Rada, 1988, p. 314; italics added).

Recently, digitization and the development of digital technologies are receiving increasing attention in servitization research (Raddats et al., 2019). Digitization essentially means the shift from analogue to digital (Storbacka, 2018). More specifically, it is a technical process that converts analog information into a digital form that can be processed by the same technologies (Tilson et al., 2010). Digitization offers several opportunities for firms, in both the back and front-end of the organization (Coreynen et al., 2017): It enables scalability in the efficient creation and delivery of products and services (Ness, Swift, Ranasinghe, Xing, & Soebarto, 2015), and also expands the reach of firms through new digital channels, such as websites and mobile devices (Weill & Woerner, 2013). Furthermore, digitization has the potential to radically change a firm's entire business model (Li, 2018), and ultimately alter its position in the supply chain (Vendrell-Herrero et al., 2017) and value chain (Kohtamäki, Parida, et al., 2019). However, digitization does not always spur disruptive change – more often than not, firms apply digital technologies to incrementally improve their current value proposition (Furr & Shipilov, 2019).

Recently, the literature has started to explore the convergence of servitization and digital technology (e.g., Frank et al., 2019; Kohtamäki et al., 2020). However, digital servitization, as a sub-stream of servitization research (Cenamor et al., 2017; Vendrell-Herrero et al., 2017), is still in a very early stage (Paschou, Adrodegari, Perona, & Saccani, 2017). Among the more than one thousand articles, only 43 discuss digital servitization (Kohtamäki, Parida, et al., 2019). So far, several interpretations of digital servitization have been posited. One is that digitization is an *enabler* for servitization. For instance, Sklyar et al. (2019) define digital servitization as the use of digital tools for servitization purposes. Within this definition, technology facilitates firms to improve service quality and reduce operational costs (Kindström & Kowalkowski, 2014). For instance, Coreynen et al. (2017) describe different pathways for digitally-enabled servitization, such as implementing technology in the back-end of the organization to customize products, and in the front-end to better manage sales and customer relations. Furthermore, digital, modular platforms enable manufacturers to orchestrate both back and front-end operations to further pursue customization and improve operational efficiency (Cenamor et al., 2017). Another interpretation is that digital technology becomes an *integral part* of the total offering. For instance, Vendrell-Herrero et al. (2017) define digital servitization as "the provision of IT-enabled (i.e. digital) services relying on digital components embedded in physical products". The low costs of sensors (Jovašević-Stojanović et al., 2015) has boosted the presence of smart, connected products and changed the way firms offer services (Porter & Heppelmann, 2014). In a similar vein, Kohtamäki, Parida et al. (2019, p. 4) define digital servitization as "the transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization, and autonomous function". In this view, firms must capitalize on products, services and software, which should all work together to gain value from digital servitization.

Though most scholars agree that digitization and servitization are inherently related (Frank et al., 2019; Kohtamäki et al., 2020), they are not the same. Firms can digitize without moving into service, and also servitize without digitization (Vendrell-Herrero et al., 2017). In the future, services may be defined as 'non-digital', 'digitally-enabled' and fully 'digital' (Raddats et al., 2019). Also, the consequences of digital servitization differ from mainstream servitization practices. For one, whereas traditional (non-digital) services complement products, digital services often replace them (Weill & Woerner, 2013). Also, digitization provides opportunities to other actors, such as distributors and retailers, which can change sectors' entire power dynamics (Cusumano, 2015) – even new entrants (sometimes without any products of their own) can create digital platforms that connect and orchestrate physical assets from suppliers into integrative offerings for customers (Linz, Zimmermann, & Müller-Stewens, 2017).

In summary, digitization and servitization are considered different yet often related strategic transitions that provide several distinct opportunities to firms. We are interested in identifying mechanisms that drive firms to pursue either digitization, servitization, or a combined digital servitization strategy. The intention is to find which dynamic capabilities are associated with each strategy, and to what extent they differ. Therefore, in the next section, we draw from the dynamic capabilities literature to gain insight in the potential internal drivers of digital servitization, before turning to the potential moderating effect of several external (i.e., environmental) contingencies.

2.2. A dynamic capabilities perspective: exploitation, exploration and ambidexterity

The servitization literature has often emphasized the importance of developing service-related capabilities for successful servitization (Fliess & Lexutt, 2017) and also digital servitization (Kohtamäki, Parida, et al., 2019). For instance, Fischer et al. (2010), Paiola, Gebauer, and Edvardsson (2012) and Kindström, Kowalkowski, and Sandberg (2013) offer extensive lists of different sensing, seizing and reconfiguring capabilities that are necessary for service development, such as continuously observing competitor's service offerings, being able to make quick and timely decisions, and redesigning processes to minimize costs and achieve profits. Furthermore, to reap the potential benefits of digital servitization, companies also need software-related skills (Kohtamäki, Parida, et al., 2019), such as the ability to connect and analyze data, which help them better interact and co-create value with customers (Lenka, Parida, & Wincent, 2017).

Though the benefits of these operational skills are clear, little is known about the strategic capabilities that drive firms towards digital servitization (Kohtamäki, Parida, et al., 2019). The dynamic capabilities view, which considers the specific competences that make firms continuously adjust their strategy depending on the environment where they are active in (Teece, Pisano, & Shuen, 1997), may offer such valuable insights. Pinpointing the dynamic capabilities associated with digital servitization is important, because they are considered the source for firms to create a sustained competitive advantage (Eisenhardt & Martin, 2000). In particular exploitation, exploration and ambidexterity turn out to be important drivers of technological innovation strategies (He & Wong, 2004). Exploitation refers to leveraging existing knowledge to refine current offerings and processes to improve efficiency, exploration to creating new knowledge by experimenting with new ideas for products, services and technologies (Bierly & Daly, 2007; March, 1991), and ambidexterity to keeping a balance between both capabilities to be efficient in managing today's business while also being adaptable for coping with tomorrow's changes (O'Reilly & Tushman, 2008, 2013; Raisch, Birkinshaw, Probst, & Tushman, 2009). In the next paragraphs, we offer several hypotheses concerning the relationships between these dynamic capabilities (i.e., exploitation, exploration and ambidexterity) and firms' orientation towards different strategies (i.e., digitization, servitization and digital servitization).

First, we hypothesize that *firms emphasizing exploitation are more likely oriented towards digitization* (H1a) and *less likely oriented towards servitization* (H1b). Exploitation is about seeking efficiency through the refinement of current offerings and processes in order to make things work better and maximize profits in the short run (Bierly & Daly, 2007; March, 1991). This resonates with firms using technology to improve efficiency in processes such as production, sales and delivery (Gastaldi & Corso, 2012; He & Wong, 2004). Examples range from metal component suppliers using software to optimize production, to switchboard manufacturers creating new web applications to expand their reach into the market (Coreynen et al., 2017). On the contrary, exploitation does not echo the ideas inextricably bound to servitization, which is a much riskier business strategy for which the benefits only become apparent over a longer period of time, if at all (Fang, Palmatier, & Steenkamp, 2008; Visnjic, Wiengarten, & Neely, 2016). In fact, exploitative firms are less likely to compete by innovating products and services (Yalcinkaya, Calantone, & Griffith, 2007).

Second, we hypothesize that *firms emphasizing exploration are more likely oriented towards digitization* (H2a) and also *more oriented towards servitization* (H2b). Exploration is about experimenting with radical ideas for new products, services and break-through technologies (Bierly & Daly, 2007), but the returns from exploration are less certain and more remote in time (March, 1991). Explorative firms today are increasingly applying new, so-called 'Industry 4.0' technologies (Blanchet, Rinn, Thaden, & Thieulloy, 2014) to integrate and further automatize different work processes (Machado, Winroth, & da Silva, 2019), and also connect with products out in the field (Porter & Heppelmann, 2014). Explorative firms have also been associated with creating new products (He & Wong, 2004; Yalcinkaya et al., 2007) and developing new service business opportunities (Fischer et al., 2010). In fact, exploration is considered vital for the development of advanced services, as opposed to exploitation, which is more associated with basic services (Kowalkowski & Kindström, 2014).

Finally, based on the above, we hypothesize that *firms simultaneously emphasizing exploitation and exploration are more likely oriented towards digital servitization* (H3). At first, it was thought that only few firms manage both exploitation and exploration due to their inability to conduct this balancing act well (Levinthal & March, 1993). Later, it was found that a trade-off is not necessary, and that both capabilities are in fact complementary (Bierly & Daly, 2007). Similar observations have been made in the context of digital servitization. For instance, He and Wong (2004) found that a combination of exploitation and exploration leads to technological innovation on both the offering and process side of the business. Moreover, according to Fischer et al. (2010), exploration does not happen without exploitation, and firms that explore the service business will also emphasize exploiting it. The paradox of continuously managing exploitation and exploration is considered necessary for successful servitization (Kohtamäki, Rabetino, & Einola, 2018). For example, according to O'Reilly & Tushman, (2013), ambidexterity is the reason why IBM, a well-known, global technology firm, was able to successfully move from being a maker of hardware to software to, ultimately, services. In short, we expect that ambidextrous firms are associated with digital servitization.

2.3. A contingency perspective: technological turbulence and competitive intensity

In addition to strategic capabilities, also changes in the environment impact firms' transition towards digital services (Fliess & Lexutt, 2017; Kohtamäki, Parida, et al., 2019). So far, scholars have investigated several environmental conditions under which servitization leads to better performance. For instance, servitization has been associated with more favorable financial results and increasing firm value when customers are more loyal (Eggert, Hogreve, Ulaga, & Muenkhoff, 2014) and when industry growth is low (Fang et al., 2008), respectively. In general, firms are advised to develop a service strategy that fits their particular environment (Gebauer, 2008).

Though studies on dynamic capabilities and the environment are useful to better understand servitization success (Fliess & Lexutt, 2017; Kohtamäki, Parida, et al., 2019), research investigating the combined role of both factors in a firm's orientation towards digital servitization, is still far and between. Further investigation is necessary because neither internal nor external factors on their own can fully explain firms' digital servitization transition (Dmitrijeva et al., 2019). In fact, the purpose of dynamic capabilities is to provide firms the ability to deal with increasingly changing environments (Ambrosini & Bowman, 2009; Teece et al., 1997). Therefore, we combine the dynamic capabilities view with a contingency theory lens. Contingency theory argues that the main associations between two variables – in this study, dynamic capabilities and strategy – offer only a simplistic view on reality, and that also the business environment in which firms operate influence strategic decision-making (Miller, 1981). Particularly the level of technological turbulence and competitive intensity, which can range from extremely stable to highly dynamic, are relevant for studying firms' marketing strategy: The first refers to the speed and impact of technological change, and the second to the presence of fierce competition that may present customers with alternative options (Jaworski & Kohli, 1993). Both constructs have also been used recently in prior servitization research using a contingency approach (e.g., Morgan et al., 2019; Zhang, Wang, Gao, & Li, 2019). In the next paragraphs, we extend hypotheses 1 and 2 by considering both environmental contingencies as moderators on the relationship between firms' emphasis on exploitation and exploration, on the one hand, and their orientation towards digitization and servitization, on the other hand.

Concerning the first, we hypothesized that both exploitative and explorative firms are more likely to develop a strategy for digitization (i.e., H1a and H2a). Building further on these hypotheses, we expect that technological advancements outside the firm will further stimulate both types of firms to do so. For instance, 3-D printing enables exploitative firms to upscale the production of customized offerings (Coreynen et al., 2017). Also, the increasing availability of so-called 'Big Data' and data analytics tools offer firms the opportunity to explore new, information-driven services (Turunen, Eloranta, & Hakanen, 2015). Alternatively, firms that are unprepared for (or dismiss) technological change may risk being left behind empty-handed. For example, a capital goods manufacturer lost visibility to its installed based and was forced to step away from offering advanced services due to changing technology (Finne et al., 2013). Therefore, we hypothesize that *there is a positive interaction effect between exploitation and technological turbulence on firms' orientation towards digitization* (H4a) and *between exploration and technological turbulence on firms' orientation towards digitization* (H4b).

Concerning the second, the presence of heavy competition is considered an antecedent for the development of industrial services (Gebauer, 2007), and the degree of competition even seems to influence new service development performance (Morgan et al., 2019). Furthermore, different levels of competition have been linked to different types of service strategies. For instance, highly competitive business environments have been associated with firms moving into after-sales and outsourcing services, and low competitive intensity with customer-support and development services (Gebauer, 2008). In the previous section, we hypothesized that exploitative firms are less likely to pursue servitization (i.e., H1b). Because they are more internally-oriented (i.e., towards improving efficiency), we expect that the level of competition has little influence on their orientation towards servitization. Therefore, we hypothesize that *there is no interaction effect between exploitation and competitive intensity on firms' orientation towards servitization* (H5a). We do expect that explorative firms, which are more externally-oriented and likely to pursue servitization (i.e., H2b), will actively consider the competition when working out their service strategy. As such, we hypothesize that *there is a positive interaction effect between exploration and competitive intensity on firms' orientation towards servitization* (H5b). We visualize these hypotheses in the conceptual framework in Fig. 1.

3. Methodology

3.1. Data collection

Over the course of one year, between May 2016 and April 2017, we distributed an online survey via e-mail among CEOs and key decision-makers at Belgian firms. Preceding the survey, a preliminary version of the questionnaire was pretested through three face-to-face interviews and five telephone interviews. Personalized e-mails in Dutch, French and English with a unique link to the survey were sent to a total of 15,942 e-mail addresses of firms drawn from Bel-first (a secondary database containing firms' legal and financial information). When available, these e-mail addresses were supplemented with personal e-

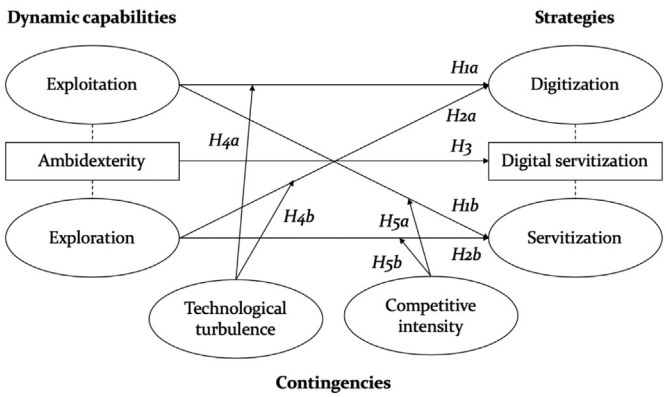

Fig. 1. Conceptual framework.

Table 1
Overview responses.

	Completed	Not-completed	Total
Survey responses	137	152	289
With all model variables	125	14	139

mail addresses of CEOs and key decision-makers from the customer relationship management (CRM) systems of Antwerp Management School, Agoria (the Belgian sector federation for the technology industry) and KPMG Belgium (a professional service firm and one of the Big Four auditors). In total, we received 289 responses of which 137 completed and 152 non-completed (see Table 1). This gives us a rather low effective response rate of 1.81%, which is probably due to the fact that most e-mail addresses were general contact e-mail addresses.

The firms in our sample cover a wide range of industries, including manufacturing (41.9%), wholesale and retail trade (20.1%), construction (10%), transportation and storage (6.2%), professional, scientific and technical activities (4.5%), financial and insurance activities (3.5%) and ten other industries (13.8%). They range from small firms with less than 50 employees (44.7%) to medium firms with 50 to 199 employees (26.3%), large firms with 200 to 999 employees (20.2%) and very large firms with more than 999 employees (8.8%). Independent *t*-tests reveal no significant differences between firms that completed the survey and those that did not complete the survey in terms of age, size and sector distribution.

To avoid potential problems related to common-method variance (CMV), we followed several suggestions made by Chang, van Witteloostuijn, and Eden (2010). First, at the start of the survey, we assured the participants of their anonymity and the confidentiality of the study, that there are no right or wrong answers, and that they should answer the questions as honestly as possible. Second, the relationships between the independent and dependent variables are rather complex, including several moderating effects, which prevented participants to be guided by a cognitive map that includes difficult-to-visualize interactions (Siemsen, Roth, & Oliveira, 2009). Finally, the items related to the business environment constructs include several reverse-coded items, which reduced the likelihood of participants giving similar answers to the items.

To ensure the quality of the information obtained, we asked respondents whether their firm is part of a larger group or entity, and if so, whether they have any authority over the firm's strategy formulation. 37.1% say that their firm is part of a larger group of which 87% said they have authority over strategy formulation. This means that less than 5% of all respondents indicate that they have no influence over their firm's strategy. We assume that decisions in these firms are taken by other entities elsewhere, such as the group's headquarters. We also asked how many years the respondents have been active in the firm and in their current function. The mean answers are 17.6 years (median = 17.0; *SD* = 11.8) and 11.9 years (median = 9.0; *SD* = 10.4), respectively. We can therefore reasonably assume that the respondents have in-depth knowledge of the way strategy is formulated within the firm.

3.2. Measures

3.2.1. Dependent variables

Digitization (DIG) and servitization (SERV) are measured through two new variables. We offered respondents a list of several major business trends, including digitization and servitization, and asked whether their firm has developed strategy for each trend using a five-point Likert scale (from 1 = 'strongly disagree' to 5 = 'strongly agree'). We consider digitization as the transition by firms from analogue to digital (Storbacka, 2018; Tilson et al., 2010), including all the tools and processes necessary to perform its various activities and create value for customers. Following Vandermerwe and Rada (1988), we consider servitization as the transition from basic goods or services to integrated offerings with services in the lead role. Because managers might not be aware of the meaning of servitization, we posited the term 'product-service integration' instead, which in the literature is often used as a synonym for servitization (e.g., Baines, Lightfoot, & Kay, 2009; Beuren, Gomes Ferreira, & Cauchick Miguel, 2013). Next, to measure whether firms have developed a strategy for digital servitization, we created two composite variables. First, we multiplied the answers to the DIG and SERV questions; the answers for this variable (DIG*SERV) thus range from 1 (i.e., the firm has neither developed a strategy for DIG nor SERV) to 25 (i.e., the firm has maximally developed a strategy for both DIG and SERV). Second, for the sake of robustness analyses, we also summed the answers to both questions; the answers for this variable (DIG + SERV) thus range from 2 to 10. In the Results section, we compare the *F*-values and differences in R^2 of the models with both measures.

3.2.2. Independent variables

Exploitation (EXPLOI) and exploration (EXPLOR) are operationalized through seven statements related to, on the one hand, increasingly enhancing the existing knowledge base through efficiency and refinement, and on the other hand, radically generating new knowledge through experimentation and stimulating creativity (Bierly & Daly, 2007). Respondents were asked to rate each statement using a five-point Likert scale (from 1 = 'strongly disagree' to 5 = 'strongly agree'). In a confirmatory factor analysis, two factors emerged: a three-item exploitation scale ($\alpha = 0.69$) and a four-item exploration scale ($\alpha = 0.79$). All items conceptually load correctly on the two factors (see Appendix A). This is similar to earlier findings by Bierly and Daly (2007), who also found a three-item exploitation ($\alpha = 0.73$) and a four-item exploration scale ($\alpha = 0.75$). Exploitation and exploration were calculated by averaging the scores of the three and four items per construct, respectively.

Next, to determine which measure to use for ambidexterity, we followed the selection procedure of Jansen, Tempelaar, van den Bosch, and Volberda (2009). First, we created two ambidexterity measures: one by multiplying EXPLOI and EXPLOR and the other by summing the two scores. Second, we ran separate linear regressions with each measure as the dependent variable and firm age and size as the independent variables. Past research has illustrated the associations between a firm's age and its emphasis on innovation. For instance, older firms are more likely to exploit opportunities, whereas younger firms are naturally more inclined towards exploration (Gilbert, 2005). Third, we compared the *F*-values and differences in R^2 of both models to select the final ambidexterity measure. The multiplicative measure proved to be superior to the additive measure with a higher R^2 ($0.018 > 0.014$).

3.2.3. Moderating variables

Technological turbulence (TECH) and competitive intensity (COMP) are measured through eleven statements related to the impact and speed of technological change, on the one hand, and competitors' speed, strength, differentiation and pricing strategy, on the other hand (Jaworski & Kohli, 1993; Kemper, Schilke, & Brettel, 2013). Respondents were asked to rate each statement using a five-point Likert scale (from 1 = 'strongly disagree' to 5 = 'strongly agree'). In a confirmatory factor analysis, two factors emerged: a five-item technological turbulence scale ($\alpha = 0.75$) and a six-item competitive intensity scale ($\alpha = 0.80$). The items conceptually load correctly on both factors (see Appendix B). This is comparable to the original study of Jaworski and Kohli (1993), who found a four-item technological turbulence scale ($\alpha = 0.88$) and a six-item competitive intensity scale ($\alpha = 0.81$). Technological turbulence and competitive intensity were calculated by averaging the scores of the five and six items per construct, respectively.

3.2.4. Control variables

Following prior ambidexterity studies (e.g., Bierly & Daly, 2007; He & Wong, 2004; Jansen et al., 2009), the first two control variables are firm age and size. Firm age (AGE) is a continuous variable calculated by subtracting the year of incorporation (drawn from Bel-first) from the year when the respondent started the survey. In our sample, AGE ranges from two to 116 years. Firm size (SIZE) is an ordinal variable consisting of nine separate range of number of employee categories (1 = '1 to 4', 2 = '5 to 9', 3 = '10 to 19', 4 = '20 to 49', 5 = '50 to 99', 6 = '100 to 199', 7 = '200 to 499', 9 = '500 to 999'; 9 = '999 < employees'). Our sample includes firms from all nine categories.

The third control variable is firms' current emphasis on either products or services (PSO). It is a nominal variable determined by the survey question: "Which of the following descriptions best fits your firm?" (1 = 'product-oriented'; 2 = 'mostly product-oriented, supported by additional services'; 3 = 'both product and service-oriented'; 4 = 'mostly service-oriented, supported by additional products'; 5 = 'service-oriented'). We chose this variable over sector as often used in prior studies (e.g., He & Wong, 2004; Jansen et al., 2009; Kemper et al., 2013) as it better captures the variety among firms in terms of their position on the product-service continuum (Oliva & Kallenberg, 2003). When comparing the responses to this question with firms' actual sectors (drawn from Bel-first), we observe that different sectors include firms from across the product-service continuum (see Appendix C). For instance, our sample contains manufacturers from all five categories, the majority emphasizing both products and services, and wholesale and retail traders cover four out of five categories, the majority also emphasizing both products and services.

3.3. Sample and method

For our final sample, we consider the cases for which the dependent, independent, moderating and control variables of our conceptual framework are available. This gives us a final sample of 139 cases (see Table 1). The remaining missing data are Missing Completely at Random (MCAR) (p = .279).

We analyze the data through hierarchical linear regressions in SPSS and the PROCESS custom dialog box for moderation modelling (Hayes, 2013). We conducted a series of regression analyses, each time adding all three control variables into the first block, the explanatory variables into the second block and the interaction terms into the third block. Obtaining generalizability of the results requires a ratio of observations to independent variables of at least five to one, and preferably fifteen to one (Hair, Black, Babin, & Anderson, 2009). As we work with a maximum of six variables (i.e., three control variables and three independent variables, or two independent variables and one interaction term), the required number of observations is minimally 30 and preferably 90. In our sample, 139 cases provide valid information (listwise), which is more than the suggested number of cases for running the analyses.

Table 2 shows the descriptive statistics and the bivariate correlations among the variables. The average firm in our sample is 37 years old, offers employment to 50 to 99 employees, and provides both products and services to customers.

The highest correlations are between exploration and technological turbulence (r = 0.50, p < .01), and exploitation and exploration (r = 0.48, p < .01). The latter confirms that both constructs are complements rather than substitutes (Bierly & Daly, 2007). Also, servitization and digitization are different but related constructs (r = 0.35, p < .01), indicating a connection between the two strategies (Kohtamäki, Parida, et al., 2019; Vendrell-Herrero et al., 2017). The maximum variance inflation factor (*VIF*) is 1.69 (i.e., for the models without interaction terms), which is well below the suggested maximum value of 10 (Neter, Kutner, Wasserman, & Nachtsheim, 1996).

4. Results

Table 3 shows the results for the models with digitization (DIG) as the dependent variable. All F-statistics are significant, and the R^2 ranges from 5.8 to 22.5%. Individually, exploitation (b = 0.45, p < .01), exploration (b = 0.46, p < .01) and technological turbulence (b = 0.39, p < .01) are all significantly and positively associated with DIG. This is in line with H1a and H2a. Yet, when combined, only the effect of exploration on DIG remains significant (b = 0.31, p < .01). Firms are thus more likely oriented towards digitization in highly technologically turbulent environments *or* when they are either highly exploitative *or* explorative. Yet, when all factors are present, the effect of exploration trumps the effect of the other two variables.

For technological turbulence (TECH), the interaction terms with exploitation (b = 0.04, p = .78) and exploration (b = −0.09, p = .45) are insignificant. On first sight, we thus have to reject H4a and H4b. Yet, when considering the Johnson-Neyman significance regions, we observe that the effect of exploitation on DIG does increase as TECH increases, but the interaction is only significant for average to high levels of TECH (see Table 4). High-exploitation firms are thus, to some extent, more likely oriented towards digitization when the environment becomes technologically more turbulent. This provides partial support for H4a. Contrary to H4b, the positive effect of exploration on DIG *decreases* as TECH increases; this time, moderation is not significant for either very low or high levels of TECH. High-exploration firms are thus increasingly less likely oriented towards digitization when the environment becomes technologically more turbulent, unless at very low or high levels of TECH.

Table 5 reports the results for the models with servitization (SERV) as the dependent variable. All of the models' F-statistics are significant and the R^2 ranges from 7.3 to 18.9%. Exploitation significantly and positively relates to SERV, but only without exploration in the model (b = 0.30, p = .02). We thus reject H1b. Alternatively, exploration is significantly and positively associated with SERV (b = 0.39, p < .01), even when exploitation is included in the model, providing support for H2b. Either high-exploration or exploitation firms are thus more likely oriented towards servitization. Yet, when both elements are present, the

Table 2
Descriptive statistics and bivariate correlations.

	Mean	SD	1	2	3	4	5	6	7	8	9
1. SERV	3.53	0.99	1								
2. DIG	3.79	0.94	0.35**								
3. EXPLOR	2.99	0.79	0.29**	0.38**							
4. EXPLOI	3.69	0.63	0.19*	0.30**	0.48**						
5. COMP	3.40	0.70	0.01	0.03	0.01	−0.06					
6. TECH	3.39	0.71	0.26**	0.31**	0.50**	0.27**	0.14				
7. AGE	37.03	21.98	0.12	−0.02	−0.12	−0.09	−0.03	0.01			
8. SIZE	5.05	2.22	0.14	0.09	−0.08	0.01	−0.06	0.14	0.23*	1	
9. PSO	2.81	1.11	0.22*	0.22*	0.02	0.03	0.04	0.15	−0.10	0.10	1

Notes: Correlations significant at the 0.05 level (2-tailed) are marked by *, and at the 0.01 level by **. Sample size = 139 (listwise).

Table 3
Linear regression results for digitization.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Outcome	DIG						
	B	B	B	B	B	B	B
Constant	3.057**	1.485**	1.701**	1.932**	0.935†	1.424**	0.747
	(0.290)	(0.521)	(0.397)	(0.423)	(0.537)	(1.717)	(1.064)
Control variables							
AGE	0.000	0.000	0.001	0.000	0.001	0.000	0.001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
SIZE	0.038	0.026	0.039	0.023	0.029	0.017	0.030
	(0.036)	(0.035)	(0.034)	(0.035)	(0.034)	(0.035)	(0.035)
PSO	0.185*	0.174*	0.173*	0.149*	0.160*	0.147*	0.164*
	(0.072)	(0.068)	(0.066)	(0.070)	(0.066)	(0.068)	(0.067)
Direct effects							
EXPLOI		0.453**			0.220†	0.235	
		(0.119)			(0.131)	(0.488)	
EXPLOR			0.458**		0.311**		0.687†
			(0.092)		(0.117)		(0.400)
TECH				0.387**	0.136	0.138	0.379
				(0.109)	(0.122)	(0.532)	(0.334)
Interaction effects							
EXPLOI*TECH						0.042	
						(0.149)	
EXPLOR*TECH							−0.089
							(0.117)
F-statistic	2.857*	5.695**	8.486**	5.445**	6.450**	5.022*	5.977**
R^2	0.058	0.144	0.201	0.135	0.225	0.185	0.212
R^2 change	0.058*	0.091**	0.148**	0.078**	0.172**	0.079	0.003
N	144	140	140	144	140	140	140

Notes: Significance levels < 0.10 marked by †, < 0.05 by *, and < 0.01 by **. Unstandardized coefficients. Standard errors in parentheses. R^2 change of Models 2–5 in comparison with Model 1; R^2 change of Models 6–7 in comparison with the same models without interaction effects. All *VIF* < or = 1.685.

effect of exploration trumps that of exploitation.

Competitive intensity (COMP) does not have a significant relation with firms' orientation towards servitization, neither directly nor as a moderator. First, the interaction with exploitation is insignificantly negative ($b = -0.11$, $p = .56$), which is in line with H5a. Second, the interaction with exploration is positive and nearly significant ($b = 0.24$, $p = .07$), which marginally confirms H5b. When considering the Johnson-Neyman significance regions, the relationships of exploitation and exploration with SERV become significant at particular values of COMP (see Table 4). We observe two interesting results. First, the positive association of exploitation with SERV decreases as COMP increases, but it is only significant around the mean value of COMP. Exploitative firms are thus increasingly less likely oriented towards servitization as the competition grows more intense, but only at average values of COMP. Second, the positive relation of exploration with SERV increases as COMP increases, but it is only significant at the mean value of COMP and above. Explorative firms are thus increasingly more likely oriented towards servitization as the competition becomes more intense, except for low values of COMP. We visualize this relationship in Fig. 2.

Tables 6 and 7 report the results for the models with the digital servitization multiplicative (DIG*SERV) and additive measure (DIG+SERV) as the dependent variable, respectively. All of the models' *F*-statistics are significant and the R^2 ranges from 9.0 to 23.7% for the models with the multiplicative measure and from 9.3 to 27.3% for the models with the additive measure. For the sake of brevity, we only discuss the results for the models with the slightly superior multiplicative measure as the dependent variable.

Exploration is positively and significantly associated with DIG*SERV ($b = 2.79$, $p < .01$). The same is true for exploitation, but only without exploration in the model ($b = 2.47$, $p < .01$). Either high-exploration or exploitation firms are thus more likely oriented towards digital servitization, but when both are present, the effect of exploration trumps that of exploitation.

Ambidexterity (i.e., the multiplicative measure of exploitation and exploration) is not significantly related with firms' orientation towards digital servitization. Hence, again, at first sight, we thus must reject H3. Yet, when considering the Johnson-Neyman significance regions, the relationship between exploration and DIG*SERV becomes significant at particular values of exploitation (see Table 4). The positive association of exploration with DIG*SERV increases as exploitation increases, but it is not significant at very low levels of exploitation. High-exploration firms are thus more likely oriented towards digital servitization when they have reached a medium level of exploitation. This partially confirms H3. We visualize the relationship in Fig. 3. However, given the absence of Johnson-Neyman significance regions for the effect of

Table 4
Moderator values defining Johnson-Neyman significance regions.

Dependent variable	Moderator	Independent variable	Moderator value range	Independent variable effect range	Region size
DIG	TECH	EXPLOIT	2.79–3.90	0.35–0.40 (+)	62.14%
DIG	TECH	EXPLOR	1.97–4.07	0.51–0.32 (−)	81.43%
SERV	COMP	EXPLOIT	2.78–3.75	0.39–0.28 (−)	49.64%
SERV	COMP	EXPLOR	2.88–5.00	0.28–0.79 (+)	76.26%
DIG*SERV	EXPLOR	EXPLOIT	No statistical significance transition points		
DIG*SERV	EXPLOIT	EXPLOR	2.60–4.97	2.18–2.67 (+)	92.81%

Notes: Increasing effects marked by (+) and decreasing effects by (−).

Table 5
Linear regression results for servitization.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Outcome	SERV						
	B	B	B	B	B	B	B
Constant	2.609**	1.473*	1.342**	2.581**	1.033	−1.970	3.781*
	(0.298)	(0.563)	(0.431)	(0.505)	(0.701)	(2.2743)	(1.477)
Control variables							
AGE	0.005	0.006	0.007	0.005	0.007†	0.006	0.006†
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
SIZE	0.034	0.039	0.049	0.034	0.048	0.041	0.043
	(0.037)	(0.037)	(0.036)	(0.037)	(0.037)	(0.038)	(0.036)
PSO	0.201**	0.191*	0.191**	0.200**	0.189**	0.197**	0.165*
	(0.074)	(0.073)	(0.071)	(0.074)	(0.071)	(0.075)	(0.072)
Direct effects							
EXPLOI		0.299*			0.092	0.706	
		(0.129)			(0.143)	(0.713)	
EXPLOR			0.386**		0.351**		−0.402
			(0.100)		(0.114)		(0.439)
COMP				0.008	0.024	0.454	−0.701
				(0.119)	(0.116)	(0.730)	(0.407)
Interaction effects							
EXPLOI*COMP						−0.113	
						(0.195)	
EXPLOR*COMP							0.238†
							(0.129)
F-statistic	3.652*	4.151**	6.751**	2.721*	4.521**	2.807*	5.117**
R^2	0.073	0.110	0.168	0.073	0.170	0.113	0.189
R^2 change	0.073*	0.036*	0.093**	0.005	0.096**	0.002	0.021†
N	143	139	139	143	139	139	139

Notes: Significance levels < 0.10 marked by †, < 0.05 by *, and < 0.01 by **. Unstandardized coefficients. Standard errors in parentheses. R^2 change of Models 2–5 in comparison with Model 1; R^2 change of Models 6–7 in comparison with the same models without interaction effects. All *VIF* < or = 1.317.

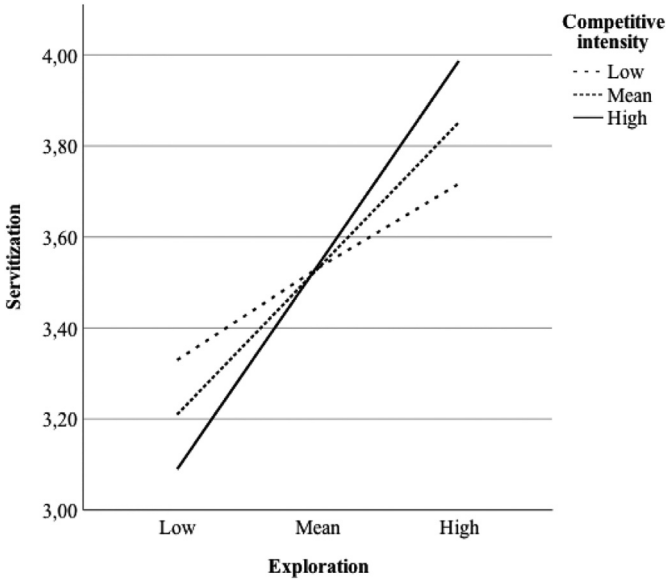

Fig. 2. Exploration on servitization at three levels of competitive intensity.

exploitation on DIG*SERV, an increase in exploitation has very little influence on firms' orientation towards digital servitization, regardless of their level of exploration.

Table 6
Linear regression for digital servitization (multiplicative measure).

	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome	DIG*SERV				
	B	B	B	B	B
Constant	7.815**	−1.019	−0.793	−3.415	−1.511
	(1.720)	(3.197)	(2.420)	(3.118)	(8.122)
Control variables					
AGE	0.015	0.018	0.022	0.023	0.023
	(0.021)	(0.022)	(0.021)	(0.021)	(0.021)
SIZE	0.319	0.282	0.355†	0.338†	0.347†
	(0.214)	(0.213)	(0.204)	(0.204)	(0.207)
PSO	1.322**	1.261**	1.264**	1.257**	1.260**
	(0.426)	(0.416)	(0.398)	(0.397)	(0.398)
Direct effects					
EXPLOI		2.470**		1.054	0.496
		(0.731)		(0.793)	(2.335)
EXPLOR			2.787**	2.386**	1.638
			(0.561)	(0.636)	(3.012)
Interaction effects					
EXPLOI*EXPLOR					0.207
					(0.816)
F-statistic	4.579**	6.164**	9.790**	8.230**	6.821**
R^2	0.090	0.155	0.226	0.237	0.237
R^2 change	0.070**	0.072**	0.143**	0.153**	0.000
N	143	139	139	139	139

Notes: Significance levels < 0.10 marked by †, < 0.05 by *, and < 0.01 by **. Unstandardized coefficients. Standard errors in parentheses. R^2 change of Models 2–4 in comparison with Model 1; R^2 change of Model 5 in comparison with Model 4. All *VIF* < or = 1.315.

5. Discussion

Based on the empirical analysis and the consulted literature, we discuss the study's most important findings. First, we find that digitization and servitization as business strategies are two different but also related constructs. There is a significant, positive correlation between firms' orientation towards servitization and digitization (r = 0.35, p < .01), which suggests a weak to moderate relationship. This confirms earlier suggestions that digitization – i.e., the shift from analogue to digital (Storbacka, 2018; Tilson et al., 2010) – is different from servitization – i.e., the transition from basic goods and services to integrated offerings (Vandermerwe & Rada, 1988). But it also means that

Table 7
Linear regression results for digital servitization (additive measure).

	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome	DIG + SERV				
	B	B	B	B	B
Constant	5.677**	2.976**	3.033**	2.247**	2.063**
	(0.472)	(0.870)	(0.651)	(0.837)	(2.181)
Control variables					
AGE	0.005	0.006	0.008	0.008	0.008
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
SIZE	0.073	0.066	0.088	0.083	0.082
	(0.059)	(0.058)	(0.055)	(0.055)	(0.056)
PSO	0.382**	0.363**	0.364**	0.362**	0.362**
	(0.117)	(0.113)	(0.107)	(0.106)	(0.107)
Direct effects					
EXPLOI		0.747**		0.316	0.370
		(0.199)		(0.213)	(0.627)
EXPLOR			0.847**	0.726**	0.799
			(0.151)	(0.171)	(0.809)
Interaction effects					
EXPLOI*EXPLOR					−0.020
					(0.219)
F-statistic	4.759**	7.061**	11.863**	9.994**	8.268**
R^2	0.093	0.174	0.261	0.273	0.273
R^2 change	0.093**	0.087**	0.174**	0.186**	0.000
N	143	139	139	139	139

Notes: Significance levels < 0.10 marked by †, < 0.05 by *, and < 0.01 by **. Unstandardized coefficients. Standard errors in parentheses. R^2 change of Models 2–4 in comparison with Model 1; R^2 change of Model 5 in comparison with Model 4. All *VIF* < or = 1.315.

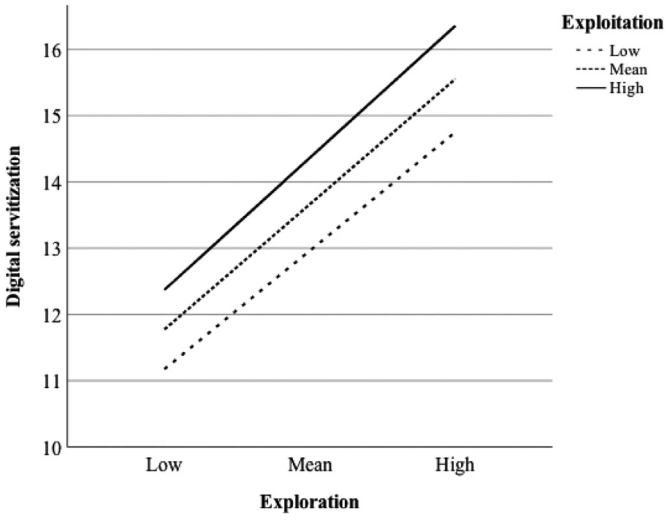

Fig. 3. Exploration on digital servitization at three levels of exploitation.

both constructs are to some extent related (Kohtamäki, Parida, et al., 2019; Vendrell-Herrero et al., 2017). Firms developing a strategy for servitization are thus more likely to develop one for digitization, and vice versa. This finding supports other studies that show digitization can be an enabler for servitization (Cenamor et al., 2017; Coreynen et al., 2017), become an integral part of the total offering (Kohtamäki, Parida, et al., 2019; Vendrell-Herrero et al., 2017), and that services in the future will be categorized as 'non-digital', 'digitally-enabled' and fully 'digital' (Raddats et al., 2019).

Second, we find that exploitation and exploration are *both* associated with digitization and servitization. In other words, either strategy is likely to be pursued by firms emphasizing both distinct capabilities. We assume that exploitative firms are likely attracted by the 'quick wins' of digitization, such as increasing efficiency through ICT (Gastaldi & Corso, 2012), whereas explorative firms are more likely interested in its long-term benefits, such as developing new insights through IoT applications (Blanchet et al., 2014). Contrary to our expectations, not only explorative but also exploitative firms are oriented towards servitization, even though it is a much riskier business strategy with more uncertain returns (Fang et al., 2008; Visnjic et al., 2016). A possible explanation is the variety of potential service strategies available to firms. Earlier work pointed towards the link between exploration and radical service business development, on the one hand, and exploitation and incremental service business development, on the other (Fischer et al., 2010). Rather than exploring new business models with customers, such as performance-based contracts, some firms become 'industrializers', which means that they exploit in-house knowledge and resources to achieve scalability in offering previously customized solutions (Kowalkowski, Windahl, Kindström, & Gebauer, 2015). Yet, when both capabilities are present, exploration consistently overshadows the effect of exploitation. One explanation is the significant, positive correlation between exploration and exploitation, which supports earlier findings that both capabilities are complementary rather than substitutes (Bierly & Daly, 2007). Firms that explore business opportunities are therefore also more likely to exploit them, which is in line with earlier assumptions on exploration and exploitation in service business development (Fischer et al., 2010).

Third, we find that both exploitation and exploration are associated with digital servitization as well. From a servitization viewpoint, we just argued that exploitative and explorative firms may prefer different service strategies, such as standardizing previously developed solutions and experimenting with new service-driven business models (e.g., making products available for use, or performance-based contracts), respectively (Kowalkowski et al., 2015). Through a digital servitization lens, it has been found that firms with different service strategies adopt different technologies to facilitate their service transformation. For example, 'industrializers' often rely on cloud computing to achieve cost efficiency in mass-customization, while 'availability providers' opt for IoT to continuously localize and monitor connected products (Ardolino et al., 2018). Considering this study's findings in light of the literature, we suspect that both exploitative and explorative firms are likely to pursue a digital servitization strategy, albeit different ones – this provides avenues for further research, which we discuss later.

Fourth, we did not find a significant relation between ambidexterity – i.e., the ability to both exploit and explore opportunities – and digital servitization. Ambidextrous firms are thus *not* more likely to pursue a digital servitization strategy. Yet, we find that once firms have reached a medium level of exploitation, the effect of exploration on digital servitization grows significantly stronger. In other words, without exploitation, explorative firms are not more likely to pursue digital servitization. A potential explanation is that once explorative firms have sufficiently exploited the opportunities provided by basic services and technologies, they will further accelerate their digital servitization transformation by moving into more advanced services and technologies as well. This relates to earlier insights that firms gradually expand their offering, from basic services to value-added solutions (Brax & Visintin, 2017; Kowalkowski et al., 2015), by linking different technologies (Ardolino et al., 2018; Porter & Heppelmann, 2014). An illustration is the case of the metal component supplier that first implemented 3-D printing to produce customized components more efficiently, and later started providing fully digital and connected production systems at customers' own location (Coreynen et al., 2017).

Fifth, we find that these relationships are further accelerated or weakened by different environmental conditions. For one, we find that technological turbulence is associated with digitization, regardless of firms' emphasis on either exploitation or exploration. In other words, firms active in environments characterized by rapid and impactful technological change, are more oriented towards digitization. As a moderator, we find that in average to high technologically turbulent environments, exploitative firms are increasingly more associated with digitization. They thus value digitization more as a potential way to

refine existing processes when the environment offers the technological means to do so, as illustrated by several previously reported firms implementing digital technologies in both the organization's back and front-end (Cenamor et al., 2017; Coreynen et al., 2017). Contrary to our expectations, we find that explorative firms are increasingly less associated with digitization when the environment is technologically more turbulent. One possible explanation is that explorative firms are reluctant to invest in new technologies when they expect they are not able to reach a sufficient return on investment – this situation has been recently referred to as the 'digitalization paradox' (Kohtamäki et al., 2020).

Finally, in terms of competition, we find that only explorative firms in moderate to highly competitive environments are increasingly associated with servitization. This is in line with prior studies, which pinpointed competitive intensity as an antecedent for the development of industrial services (Gebauer, 2007; Morgan et al., 2019). Explorative firms are more likely aware of the urgency to differentiate from competitors by moving into servitization. On the contrary, exploitative firms are less associated with servitization when competition becomes more intense. This relates to the literature on 'deservitization' (e.g., Kowalkowski, Gebauer, Kamp, & Parry, 2017a; Valtakoski, 2017), which considers the conditions under which firms decide that it is more beneficial to move away from service. One possible explanation is that exploitative firms prefer to deal with an increasingly competitive environment by focusing on their core business, thus spending less efforts on developing new ideas for integrated offerings.

6. Conclusions

6.1. Theoretical contributions

Despite the increasing attention to digital servitization (Kohtamäki, Parida, et al., 2019), little is known about the factors that drive firms to develop a digital servitization strategy. To date, the literature has focused on the convergence of servitization and digitization (Frank et al., 2019), their combined impact on firms' business models (Coreynen et al., 2017), and their financial performance (Kohtamäki et al., 2020). Yet, the servitization literature still lacks the theoretical foundation to explain why firms venture into digital servitization in the first place (Kowalkowski, Gebauer, & Oliva, 2017b). This study offers new insights to the digital servitization literature by investigating its drivers from both an internal perspective (i.e., dynamic capabilities; Teece, 2007) and external perspective (i.e., contingency theory; Miller, 1981). Based on the consulted literature and our analysis of the data collected for this study, we offer the following theoretical contributions.

Concerning the internal drivers, we find that both exploitation and exploration (March, 1991) are associated with firms pursuing a digital servitization strategy. Though operational skills, such as the ability to analyze data and make quick decisions, are useful to turn servitization into a success (Lenka et al., 2017; Paiola et al., 2012), dynamic capabilities are necessary to continuously adjust firms' strategy (Teece et al., 1997). Without the ability to either exploit or explore, for instance by refining current or adopting breakthrough technologies, firms are less likely to change through digitization, servitization, or a combined digital servitization strategy. This makes them vulnerable for environmental changes, such as shifting technologies that may jeopardize their position in the value chain (Finne et al., 2013; Vendrell-Herrero et al., 2017) and other suppliers competing to serve customers' increasingly heterogeneous demands (Eggert et al., 2014; Raddats et al., 2016).

Concerning the external drivers, we find that different environments moderate the identified dynamic capability-strategy relationships. The context in which firms operate, indeed, does matter (Dmitrijeva et al., 2019), as firms deal with environmental change differently depending on their dynamic capabilities. For instance, we find that exploitative firms are more likely to pursue digitization when the technology in their sector is turbulent, and explorative firms are more likely to venture into servitization when competition is intense. Firms will thus adjust their strategy not only depending on their dynamic capabilities, but also on the environment in which they are active (Teece et al., 1997). Therefore, looking into digital servitization from a dynamic capabilities lens offers only a simplified perspective of firms' strategic transition, and the influence of the environment in which they are active should also be recognized.

In summary, in order to fully understand firms' strategic transition towards digital servitization, both firm-internal and external factors should be considered. This study contributes to the literature by pinpointing two strategic capabilities – i.e., exploitation and exploration – for digital servitization (Kohtamäki, Parida, et al., 2019), as well as the influence of two environmental factors – i.e., technological turbulence and competitive intensity – on this strategic change (Fliess & Lexutt, 2017).

6.2. Managerial implications

From a business perspective, servitization and digitization have been described as two "megatrends" that "make business model transformation a key strategic priority for many leaders" (Linz et al., 2017, p. 5). Based on this study's results, we offer several implications for managers. Most notably, we highlight the importance of developing dynamic capabilities for the purpose of strategic change in general, and digital servitization in particular. Either by actively exploiting or exploring opportunities, firms are more likely to adapt their service strategy, which is necessary to maintain a sustainable competitive advantage (Eisenhardt & Martin, 2000). In practice, this means firms need to frequently adjust their technologies and procedures to improve efficiency, and also create time to discuss and experiment with new ideas that challenge conventional wisdoms. For example, traditional manufacturers can think about which production processes would benefit most from digitization, and how they can further support customers by moving into services. In a later stage, they can explore opportunities for digital servitization, for instance by adding sensors to their products, which unlocks the possibility to connect with customers and provide data-driven services (e.g., remote monitoring and preventive maintenance). Without such dynamic capabilities, firms are likely unable to adapt their strategy to an increasingly digital, customer-driven and competitive business environment.

Furthermore, by developing such dynamic capabilities, firms are more likely to take into account the changes of the environment in which they are active. Finding a right fit with the environment is important, because this may lead to different services strategies that better match different environments (Gebauer, 2008) and ultimately increase firm performance (Eggert et al., 2014; Fang et al., 2008). As this study shows, when there is much technological change, firms are more likely to digitize, especially if they are focused on exploitation; when the competition is intense, firms are likely to servitize when they are focused on exploration. Therefore, we suggest that firms pay close attention to their environment, and that developing dynamic capabilities is even more important to adapt in highly evolving and turbulent sectors.

6.3. Limitations and suggestions for future research

This study has several limitations. First, the single-item variables for servitization and digitization offer only limited insights in the drivers of different types of digital servitization. Our study, though one of the first to contribute to the theoretical underpinnings of digital servitization, therefore only scratches the surface of the drivers of digital servitization. Second, the data stems from a single survey completed by single respondents. To avoid potential CMV, we made sure the respondents were well-informed about the firm's strategy, capabilities and environment. We also used several techniques when developing the

survey to prevent single-respondent bias, such as the inclusion of reverse-coded items. Third, technological turbulence and competitive intensity are based on respondents' perception of the environment that their firm is active in. Such subjective measures are open to interpretation and may not reflect the actual rate of technological change and competition across firms and sectors.

As opportunities for further research, a potentially fruitful next step is to consider the drivers of different types of digitization, servitization and digital servitization. For instance, future studies could draw from previous scales from the literature, such as the one developed by Partanen, Kohtamäki, Parida, and Wincent (2017) on different service offerings, and Jayachandran, Sharma, Kaufman, and Raman (2005) on different levels of digitalization, which have also been used recently to investigate the relationship with firms' financial performance (Kohtamäki et al., 2020). Such studies may provide further insights into the relationship between dynamic capabilities and firms' orientation towards different types of service offerings (Kowalkowski et al., 2015) and digitization levels, respectively. Another opportunity is to further look into the effects of digital servitization on performance, taking into account the relationship between different capabilities and environments. For example, it might be more beneficial for firms to develop incremental digital service opportunities through exploitation in *less* dynamic environments and develop radical opportunities through exploration in *more* dynamic environments. A combined configurational and contingency approach (e.g., Flynn, Huo, & Zhao, 2010; Kohtamäki, Henneberg, Martinez, Kimita, & Gebauer, 2019) may shed further light on the most optimal conditions for digital servitization.

Appendix A. Factor analysis results for the exploitation and exploration items

	CFA	
	Factor 1	Factor 2
Exploitation		
1. At our firm, a strong emphasis is placed on improving efficiency.	0.855	0.180
2. Our firm excels at refining existing technologies.	0.706	0.512
3. We frequently adjust our procedures, rules, and policies to make things work better.	0.786	0.312
Exploration		
1. We frequently experiment with radical new ideas (or ways of doing things).	0.286	0.825
2. At our firm, employees frequently come up with creative ideas that challenge conventional ideas.	0.320	0.779
3. A high percentage of our firm's sales come from recently launched products or services.	0.155	0.773
4. We are usually one of the first firms in our industry or sector to use new, breakthrough technologies.	0.401	0.742

Notes: Extraction method: Principal Component Analysis. Rotation method: Oblimin with Kaiser Normalization. Total percentage of variance explained: 63.2%.

Appendix B. Factor analysis results for the business environment items

	CFA	
	Factor 1	Factor 2
Technological turbulence		
1. The technology in our industry or sector is changing rapidly.	0.840	0.230
2. Technological developments in our industry or sector are rather minor. (rc)	0.775	0.247
3. Technological changes provide big opportunities in our industry or sector.	0.686	−0.193
4. It is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.	0.451	0.129
5. A large number of new product or service ideas have been made possible through technological breakthroughs in our industry.	0.776	−0.032
Competitive intensity		
1. Competition in our industry or sector is cutthroat.	0.114	0.802
2. There are many “promotion wars” in our industry or sector.	0.010	0.799
3. Anything that one competitor can offer, others can match readily.	−0.071	0.591
4. Price competition is a hallmark for our industry or sector.	0.051	0.795
5. One hears of a new competitive move almost every day.	0.364	0.711
6. Our competitors are relatively weak. (rc)	0.138	0.516

Notes: Extraction method: Principal Component Analysis. Rotation method: Oblimin with Kaiser Normalization. Total percentage of variance explained: 53.4%. Reverse-coded items marked by (rc).

Appendix C. Crosstabs firms' product-service orientation (PSO) x NACE codes

Sector	P-oriented	Mostly P-oriented	Both P & S-oriented	Mostly S-oriented	S-oriented	Total
Manufacturing	15	24	25	8	1	73
Wholesale & retail trade	4	9	15	3	0	31
Other sectors	4	4	15	20	9	52
Total	23	37	55	31	10	156

Notes: P = product; S = service. Other sectors with more than 5 firms in our sample include construction (n = 12), professional, scientific and technical activities (n = 9), transportation and storage (n = 8), finance and insurance (n = 7) and information and communication (n = 5). In total, 156 respondents answered the PSO question, which is more than the final sample of 139 cases for which also the other model variables are available.

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